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INVESTIGATION OF THE STRUCTURAL AND MECHANICAL PROPERTIES OF METAL CERAMICS

Metallurgists and scientific workers in the field of powder metallurgy have long maintained that lubrication introduced into a mixture serves only to lower the friction coefficient and has no effect on the pressability of powders. This opinion is based on experiments conducted in an erroneous manner from the physicochemical viewpoint.

The influence of lubrication on the pressability of powders may be easily revealed if a given lubricant contains a definite optimum amount of a surface-active component. This optimum amount must correspond to the monomolecular adsorption coating of the entire free metal powder surface with the surface-active substance. Such a monomolecular adsorption layer considerably facilitates a metal's deformation, as was demonstrated earlier in works of Academician P. A. Rebinder and Doctor of Physico-mathematical Sciences V. I. Likhtman.

Recently, V. I. Likhtman and his co-workers conducted experiments in the Institute of Physical Chemistry and obtained new and interesting results which substantially modify the old conception of the lubrication effect on processes of pressing and sintering metal powders. Investigations were conducted with powders of iron, copper, and tin over a wide range of pressing and sintering temperatures. A solution of oleic acid in vaseline oil and several other substances were used as surface-active lubricants.

Experiments revealed that the pressing pressure required for attaining a given porosity is decreased under the effect of the surface-active lubricant by 10-15 percent for copper powder, by 20 percent for iron, and by 40 percent for tin powder. In addition, the "elastic aftereffect" -- elastic expansion of the work piece after extraction from the container -- also decreases sharply. For example, the elastic expansion after pressing is three to four times lower for copper and eight to ten times less for tin. This factor is extremely essential in the technology of the metal-ceramic process since high elastic aftereffect causes a high rejection rate.

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Investigation of the electric conductivity of copper powder during the pressing process proved that the presence of a surface-active lubricant causes a sharp increase in the electric conductivity of pressed products, which fact indicates a considerable increase in internal contact surface. For example, in the case of freshly reduced copper, the conductivity of dry pressed material (pressure of 50 kilograms per square millimeter) under a die, is $1.25 \cdot 10^3$ mho's while in the presence of an active lubricant and with the same pressure, conductivity equals $5 \cdot 10^3$ mho's.

It has been revealed by studying the sintering process of copper pressed products that the temperature of the beginning of recrystallization is near 400 degrees centigrade and does not depend on pressure (in the range from 10 to 50 kilograms per square millimeter). Sintering of copper pressed materials, in which an active lubricant was included, results in smaller grain size,

Mechanical properties of sintered materials pressed with active lubricants are considerably improved, as compared to sintered dry-pressed products. For example, the abrasive wear on a Skoda-Savin machine is reduced by more than half for pressed products which contain an active lubricant before sintering. This increase in abrasive resistance is equivalent to a reduction of sintering temperature by 200 degrees (600 degrees for pressing with active lubricants instead of the 800 degrees used in dry pressing).

The results obtained give reason to believe that the use of surface-active lubricants in metal-ceramics production technology will bring about an improvement in the usefulness of the items produced, reduce rejection, and increase the service life of the equipment.

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